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Connected Science

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Looking Into the Past: How Reconstructing Historical Forest Conditions Can Help Future Restoration Efforts

A Challenge for Forest Restoration Efforts

In the western United States, many forests that had adapted to survive frequent fire look much different than they used to. Past and current management practices ranging from fire exclusion to timber harvesting and grazing have altered species composition and left forests with greater tree density. These changes leave extensive areas vulnerable to *uncharacteristic high-intensity* wildfire killing trees that had survived fires over centuries. How can we restore ponderosa pine-dominated forests today to make them more resilient to future fires especially given this quandary: no one alive today remembers what these places looked like in the past, and records about these forests are limited?

Using Tree Rings to Reconstruct the Past

Scientists from the Rocky Mountain Research Station (RMRS), Colorado Forest Restoration Institute (CFRI), and Rocky Mountain Tree Ring Research (RMTRR) teamed up to address the question of how forests were structured. The article, "Changes in forest structure since 1860 in ponderosa pine dominated forests in the Colorado and Wyoming Front Range, USA," details the findings. The science team deployed investigative dendrochronology methods over the full extent of the Front Range (across 28 sample areas including the Pike-San Isabel and Arapaho & Roosevelt National Forests) to reconstruct a picture of Colorado and Wyoming's past

Fire-scarred ponderosa pine
(*Pinus ponderosa*)
Hall Ranch Open Space
Sample ID: HA16 F3
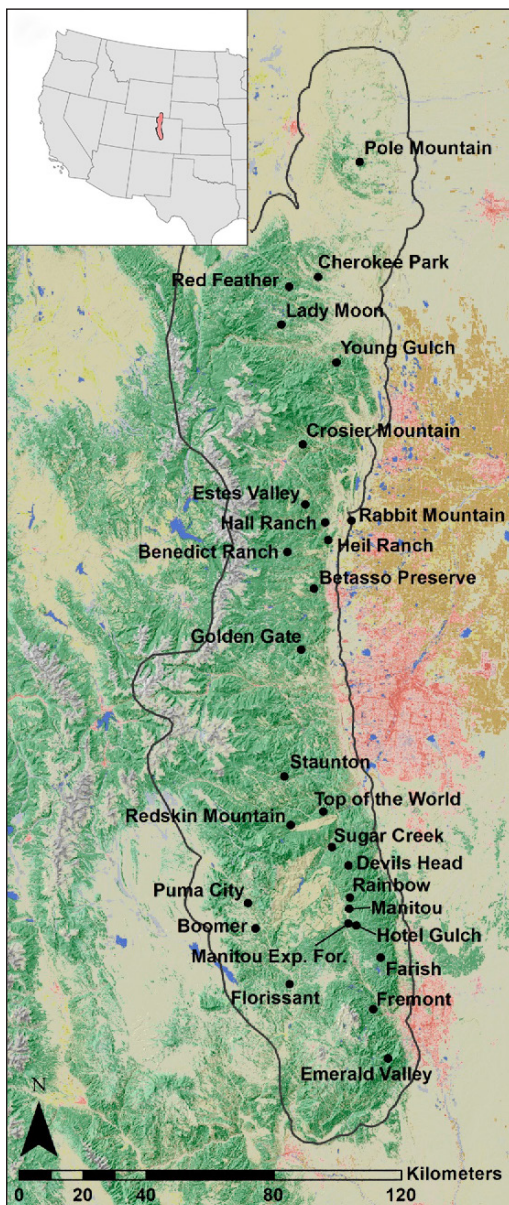Front Range Forest Reconstruction Network

Scientists are using tree ring science to visualize ponderosa forest conditions from nearly 160 years ago. Pictured above is a fire-scarred ponderosa pine sample from Hall Ranch Open Space, Boulder County, CO (Photo by P. Brown, Rocky Mountain Tree-Ring Research).

Apply the Science

- Scientists from the Rocky Mountain Research Station, Colorado Forest Restoration Institute, and Rocky Mountain Tree Ring Research reconstructed historical forest conditions in Front Range forests that had adapted to survive frequent fire prior to 1860.

- This study, which was the most extensive of its kind in the region to date, found that at lower elevations within the montane zone, average tree density had quadrupled while the proportion of Douglas-fir that contributed to tree density had doubled. At higher elevations within the montane zone, average tree densities had more than doubled and the proportion of Douglas-fir had also risen significantly.

- Forest managers can use information about historical forest structure to prioritize restoration treatments that improve resilience to fire and other disturbances.

- The scientists behind this work are available to help interpret findings from ponderosa forests in the western United States. Connect with Mike Battaglia at https://www.fs.usda.gov/rmrs/people/mbattaglia for additional information.

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forests. RMRS research forester and lead author Mike Battaglia explains, "We cored live trees and collected cross-sections of logs, snags and stumps. By comparing the ring patterns in the cross-sections with the cores from older living trees, we could figure out how old the tree was when it was cut, when it was cut and what the conditions were like in 1860."

The scale of this project is unprecedented in the region, and collaboration between the research organizations was crucial as the team sampled 13,741 live trees, 2,579 logs, 1,863 snags and 4,578 stumps over 200 miles. CFRI scientists had the capacity to conduct field collections, manage data, read tree rings, and assist Battaglia with analysis and interpretation of the resulting data. Compared to 1860, the team found present-day montane forests had significant increases in tree stand density, more Douglas-fir trees, and lower average tree diameters. According to Battaglia, before this research, "we knew that changes had occurred across the West but we didn't know how big a change there had been on the Colorado Front Range." The work done through this collaboration represents big strides towards defining the extent of these forest changes.

Learning From the High Park Fire

RMRS, CFRI and RMTRR scientists hope their research will help guide forest treatments that improve resiliency in the particularly ecologically vulnerable and highly populated Colorado Front Range region, where severe fire can damage the soil and make ecosystem regeneration difficult. Tony Cheng, Director of the Colorado Forest Restoration Institute and co-author of the study explains, "There was an area in the Arapaho & Roosevelt National Forests that we sampled in 2012 that showed a lot of in-growth of ponderosa pine and Douglas-fir. A month after we took the samples, the High Park Fire hit the area. Everything there's dead now, including several trees that were already growing prior to 1860 and had survived several fires because of the more open conditions historically. This is why we're doing this research, to help conserve our ponderosa pine and Douglas-fir forest ecosystems in the face of inevitable future wildfires."

FURTHER READING

Battaglia, Mike A.; Gannon, Benjamin; Brown, Peter M.; [et al.]. 2018. Changes in forest structure since 1860 in ponderosa pine dominated forests in the Colorado and Wyoming Front Range, USA. Forest Ecology and Management. 422: 147–160.

Brown, P.M.; Battaglia, M.A.; Gannon, B.; [et al.]. 2015. Historical (1860) forest structure in ponderosa pine forests of the northern Front Range, Colorado. Canadian Journal of Forest Research. 45: 1462–1473.

Addington, Robert N.; Aplet, Gregory H.; Battaglia, Mike A.; [et al]. 2018. Principles and practices for the restoration of ponderosa pine and dry mixed-conifer forests of the Colorado Front Range. RMRS-GTR-373. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 121 p.

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